
ANNALS OF BOTANY

Founded 1887

Volume 67 (January to June) 1991

Academic Press

Harcourt Brace Jovanovich, Publishers

London San Diego New York Boston Sydney Tokyo Toronto

C.A.B. INTERNATIONAL INSTITUTE OF PARASITOLOGY
395A, HATFIELD ROAD,
ST. ALBANS,
HERTS. AL4 0XU
U.K.

CONTENTS

Volume 67

Number 1

January 1991

Editorial	1
Chandra Sekhar, K. N. and Sawhney, V. K. Regulation of Leaf Shape in the Solanifolia Mutant of Tomato (<i>Lycopersicon esculentum</i>) by Plant Growth Substances	3
Mitchell, R. A. C., Lawlor, D. W. and Young, A. T. Dark Respiration of Winter Wheat Crops in Relation to Temperature and Simulated Photosynthesis	7
Plummer, J. A., Vine J. H. and Mullins, M. G. Regulation of Stem Abscission and Callus Growth in Shoot Explants of Sweet Orange [<i>Citrus sinensis</i> (L.) Osbeck]	17
Kuang, A., Peterson, C. M. and Dute, R. R. Changes in Soybean Raceme and Petiole Anatomy Induced by 6-Benzylaminopurine	23
Periasamy, K. and Amalathas, J. Absence of Callose and Tetrad in the Microsporogenesis of <i>Pandanus odoratissimus</i> with Well-formed Pollen Exine	29
Miller, R. M., Kaul, V., Hutchinson, J. F. and Richards, D. Adventitious Shoot Regeneration in Carnation (<i>Dianthus caryophyllus</i>) from Axillary Bud Explants	35
Pritchard, H. W. Water Potential and Embryonic Axis Viability in Recalcitrant Seeds of <i>Quercus rubra</i>	43
Rosa, L. M., Dillenburg, L. R. and Forseth, I. N. Responses of Soybean Leaf Angle, Photosynthesis and Stomatal Conductance to Leaf and Soil Water Potential	51
Alm, D. M. and Nobel, P. S. Root System Water Uptake and Respiration for <i>Agave deserti</i> : Observations and Predictions Using a Model Based on Individual Roots	59
Niklas, K. J. Biomechanical Responses of <i>Chamaedorea</i> and <i>Spathiphyllum</i> Petioles to Tissue Dehydration	67
Webb, J. and Sheehy, J. E. Legume Nodule Morphology with Regard to Oxygen Diffusion and Nitrogen Fixation	77
Sheehy, J. E. and Webb, J. Oxygen Diffusion Pathways and Nitrogen Fixation in Legume Root Nodules	85
Book Review	93
Errata	95

Number 2

February 1991

Larigauderie, A., Ellis, B. A., Mills, J. N. and Kummerow, J. The Effect of Root and Shoot Temperatures on Growth of <i>Ceanothus greggii</i> Seedlings	97
Borrell, A. K., Incoll, L. D. and Dalling, M. J. The Influence of the <i>Rht</i> ₁ and <i>Rht</i> ₂ Alleles on the Growth of Wheat Stems and Ears	103
Hume, D. E. Leaf and Tiller Production of Prairie Grass (<i>Bromus willdenowii</i> Kunth) and Two Ryegrass (<i>Lolium</i>) Species	111

Sheehy, J. E. Theory of a Crop Enclosure System for Measuring Nitrogen Fixation, Photosynthesis, Respiration and Biological Processes in the Soil	123
Sheehy, J. E., Woodward, F. I. and Gosse, G. Measurements of Nitrogen Fixation (C_2H_2), Photosynthesis and Respiration Using an Open System in the Natural Environment	131
Causton, D. R. Plant Growth Analysis: The Variability of Relative Growth Rate Within a Sample	137
Maimon, E. and Moore, R. Graviresponsiveness of Surgically Altered Primary Roots of <i>Zea mays</i>	145
Calvin, C. L., Wilson, C. A. and Varughese, G. Growth of Longitudinal Strands of <i>Phoradendron juniperinum</i> (Viscaceae) in Shoots of <i>Juniperus occidentalis</i>	153
Huang, B. R., Taylor, H. M. and McMichael, B. L. Effects of Temperature on the Development of Metaxylem in Primary Wheat Roots and Its Hydraulic Consequence	163
Rahim, M. A. and Fordham, R. Effect of Shade on Leaf and Cell Size and Number of Epidermal Cells in Garlic (<i>Allium sativum</i>)	167
Arumuganathan, K., Dale, P. J. and Cooper, J. P. Vernalization in <i>Lolium temulentum</i> L.: Responses of <i>In Vitro</i> Cultures of Mature and Immature Embryos, Shoot Apices and Callus	173
Greenwood, D. J., Gastal, F., Lemaire, G., Draycott, A., Millard, P. and Neeteson, J. J. Growth Rate and %N of Field Grown Crops: Theory and Experiments	181
Errata	191

Number 3

March 1991

Meakin, P. J. and Roberts, J. A. Anatomical and Biochemical Changes Associated with the Induction of Oilseed Rape (<i>Brassica napus</i>) Pod Dehiscence by <i>Dasineura brassicae</i> (Winn.)	193
Juned, S. A., Jackson, M. T. and Ford-Lloyd, B. V. Genetic Variation in Potato Cv. Record: Evidence from <i>In Vitro</i> 'Regeneration Ability'	199
Wolfe, D. W. Low Temperature Effects on Early Vegetative Growth, Leaf Gas Exchange and Water Potential of Chilling-sensitive and Chilling-tolerant Crop Species	205
Zobel, A. M., Brown, S. A. and Nighswander, J. E. Influence of Acid and Salt Sprays on Furanocoumarin Concentrations on the <i>Ruta graveolens</i> Leaf Surface	213
Thornley, J. H. M. A Model of Leaf Tissue Growth, Acclimation and Senescence	219
Jackson, M. B., Abbott, A. J., Belcher, A. R., Hall, K. C., Butler, R. and Cameron, J. Ventilation in Plant Tissue Cultures and Effects of Poor Aeration on Ethylene and Carbon Dioxide Accumulation, Oxygen Depletion and Explant Development	229
Martinez, F., Ascaso, C. and Orus, M. I. Morphometric and Stereologic Analysis of <i>Chlorella vulgaris</i> Under Heterotrophic Growth Conditions	239
Pennazio, S. and Roggero, P. Rapid Ethylene Production in Soybean in Response to the Cupric Ion	247

Scott, B. J. and Robson, A. D. The Distribution of Mg, P and K in the Split Roots of Subterranean Clover	251
Alizadeh, S. and Mantell, S. H. Early Cellular Events During Direct Somatic Embryogenesis in Cotyledon Explants of <i>Solanum aviculare</i> Forst.	257
Hatch, D. J. and Macduff, J. H. Concurrent Rates of N ₂ Fixation, Nitrate and Ammonium Uptake by White Clover in Response to Growth at Different Root Temperatures	265
Book Reviews	275

Number 4

April 1991

Moore, R. and Langenkamp, M. Tissue Partitioning During Leaf Development in Ornamentally-grown <i>Frithia pulchra</i> (Mesembryanthemaceae), a 'Window Plant'	279
Sharma, E. and Ambasht, R. S. Biomass, Productivity and Energetics in Himalayan Alder Plantations	285
Chapman, D. F., Robson, M. J. and Snaydon, R. W. The Influence of Leaf Position and Defoliation on the Assimilation and Translocation of Carbon in White Clover (<i>Trifolium repens</i> L.). 1. Carbon Distribution Patterns	295
Chapman, D. F., Robson, M. J. and Snaydon, R. W. The Influence of Leaf Position and Defoliation on the Assimilation and Translocation of Carbon in White Clover (<i>Trifolium repens</i> L.). 2. Quantitative Carbon Movement	303
Bal, A. K. and Siddique, A. B. M. Fine Structure of Peanut Root Nodules Induced by Nod ⁺ Fix ⁻ Strains of <i>Bradyrhizobium</i> with Special Reference to Lipid Bodies	309
Yam, T. W., Ichihashi, S. and Arditti, J. Callus Growth and Plantlet Regeneration in Taro, <i>Colocasia esculenta</i> var. <i>esculenta</i> (L) Schott (Araceae)	317
Bunce, J. A. and Caulfield, F. Reduced Respiratory Carbon Dioxide Efflux During Growth at Elevated Carbon Dioxide in Three Herbaceous Perennial Species	325
McKinless, J. and Alderson, P. G. An Anatomical Study of Rhizome Bud Formation Induced by Paclobutrazol and Adventitious Root Formation in <i>In Vitro</i> Cultures of <i>Lapageria rosea</i> (Ruiz et Pav.)	331
Gay, A. P. and Eagles, C. F. Quantitative Analysis of Cold Hardening and Dehardening in <i>Lolium</i>	339
Nagl, W., Knapp, B. and Bill, O. The Complex Satellite DNA of <i>Tropaeolum majus</i> L.: Partial Characterization of Isolated and of Cloned Restriction Fragments	347
Varney, G. T., Canny, M. J., Wang, X. L. and McCully, M. E. The Branch Roots of <i>Zea</i> . I. First Order Branches, Their Number, Sizes and Division Into Classes	357
Book Reviews	365

Number 5

May 1991

Aloni, B., Pashkar, T. and Karni, L. Partitioning of [^{14}C]sucrose and Acid Invertase Activity in Reproductive Organs of Pepper Plants in Relation to Their Abscission Under Heat Stress	371
Aloni, R. and Baum, S. F. Naturally Occurring Regenerative Differentiation of Xylem Around Adventitious Roots in <i>Luffa cylindrica</i> Seedlings	379
MacKenzie, K. A. D. and Costa Tura, J. Xylem Development in the Gynoecium of the Apple (<i>Malus pumila</i> L.) Cv. Cox's Orange Pippin	383
Konsens, I., Offir, M. and Kigel, J. The Effect of Temperature on the Production and Abscission of Flowers and Pods in Snap Bean (<i>Phaseolus vulgaris</i> L.)	391
Bernardello, L. M., Galetto, L. and Julian, H. R. Floral Nectar, Nectary Structure and Pollinators in Some Argentinean <i>Bromeliaceae</i>	401
Khatri, R., Sethi, V. and Kaushik, A. Inter-population Variations of <i>Kochia indica</i> During Germination Under Different Stresses	413
Lo Gullo, M. A. and Salleo, S. Three Different Methods for Measuring Xylem Cavitation and Embolism: A Comparison	417
Sheoran, I. S., Sawhney, V., Babbar, S. and Singh, R. <i>In Vivo</i> Fixation of CO_2 by Attached Pods of <i>Brassica campestris</i> L.	425
Huyghe, C. Winter Growth of Autumn-sown White Lupin (<i>Lupinus albus</i> L.): Main Apex Growth Model	429
Chida, Y. and Ueda, K. Division of Chloroplasts in a Green Alga, <i>Trebouxia potteri</i>	435
Smith, D. L. and Krikorian, A. D. Growth and Maintenance of an Embryogenic Cell Culture of Daylily (<i>Heimerocallis</i>) on Hormone-free Medium	443
Andrews, M., McKenzie, B. A. and Jones, A. V. Nitrate Effects on Growth of the First Four Main Stem Leaves of a Range of Temperate Cereals and Pasture Grasses	451
Coleman, M., Davie, P., Vessey, J. and Powell, W. Intracloonal Genetic Variation for Protoplast Regenerative Ability Within <i>Solanum tuberosum</i> cv. Record	459
Harmer, R. The Effect of Bud Position on Branch Growth and Bud Abscission in <i>Quercus petraea</i> (Matt.) Liebl.	463
Book Reviews	469

Number 6

June 1991

Serrato-Valenti, G., Cornara, L., Modenesi, P. and Profumo, P. The Aril of the <i>Strelitzia reginae</i> Banks Seed: Structure and Histochemistry	475
Paolillo, Jr., D. J., Sorrells, M. E. and Keyes, G. J. Gibberellic Acid Sensitivity Determines the Length of the Extension Zone in Wheat Leaves	479
Stüttzel, H. and Aufhammer, W. Dry Matter Partitioning in a Determinate and an Indeterminate Cultivar of <i>Vicia faba</i> L. Under Constrasting Plant Distributions and Densities	487

Hansen, A., Pate, J. S. and Hansen, A. P. Growth and Reproductive Performance of a Seeder and a Resprouter Species of <i>Bossiaea</i> as a Function of Plant Age After Fire	497
El Hadrami, I., Carron, M. P. and D'Auzac, J. Influence of Exogenous Hormones on Somatic Embryogenesis in <i>Hevea brasiliensis</i>	511
Jain, R. K., Jain, S. and Chowdhury, J. B. <i>In Vitro</i> Selection for Salt Tolerance in <i>Brassica juncea</i> L. Using Cotyledon Explants, Callus and Cell Suspension Cultures	517
Ahmad, I., Day, J. P., MacDonald, M. V. and Ingram, D. S. Haploid Culture and UV Mutagenesis in Rapid-cycling <i>Brassica napus</i> for the Generation of Resistance to Chlorsulfuron and <i>Alternaria brassicicola</i>	521
Ariyo, O. J. and Odulaja, A. Numerical Analysis of Variation Among Accessions of Okra [<i>Abelmoschus esculentus</i> (L.) Moench], Malvaceae	527
Hume, D. E. Effect of Cutting on Production and Tillering in Prairie Grass (<i>Bromus willdenowii</i> Kunth) Compared With Two Ryegrass (<i>Lolium</i>) Species. 1. Vegetative Plants	533
Baum, S. F., Aloni, R. and Peterson, C. A. Role of Cytokinin in Vessel Regeneration in Wounded <i>Coleus</i> Internodes	543
Nobel, P. S. and Lee, C. H. Variations in Root Water Potentials: Influence of Environmental Factors for Two Succulent Species	549
Gambardella, R. and Alfano, F. Plastid Tubules in the Sporogenous Lineage of the Moss <i>Timmiella barbuloidea</i> (Bryophyta): An Ultrastructural Study	555
Ferrer, M. A., Muñoz, R. and Ros Barceló, A. A Biochemical and Cytochemical Study of the Cuticle-associated Peroxidases in <i>Lupinus</i>	561
Book Reviews	569
Erratum	573

Author Index

- ABBOTT, A. J. (see JACKSON, M. B.), 229
- AHMAD, I., DAY, J. P., MACDONALD, M. V. & INGRAM, D. S., Haploid culture and UV mutagenesis in rapid-cycling *Brassica napus* for the generation of resistance to chlorsulfuron and *Alternaria brassicicola*, 521
- ALDERSON, P. G. (see MCKINLESS, J.), 331
- ALFANO, F. (see GAMBARDILLA, R.), 555
- ALIZADEH, S. & MANTELL, S. H., Early cellular events during direct somatic embryogenesis in cotyledon explants of *Solanum aviculare* Forst., 257
- ALM, D. M. & NOBEL, P. S., Root system water uptake and respiration for *Agave deserti*: observations and predictions using a model based on individual roots, 59
- ALONI, B., PASHKAR, K. & KARNI, L., Partitioning of [¹⁴C]sucrose and acid invertase activity in reproductive organs of pepper plants in relation to their abscission under heat stress, 371
- ALONI, R. & BAUM, S. F., Naturally occurring regenerative differentiation of xylem around adventitious roots in *Luffa cylindrica* seedlings, 379
- , (see BAUM, S. F.), 543
- AMALATHAS, J. (see PERIASAMY, K.), 29
- AMBASHT, R. S. (see SHARMA, E.), 285
- ANDREWS, M., MCKENZIE, B. A. & JONES, A. V., Nitrate effects on growth of the first four main stem leaves of a range of temperate cereals and pasture grasses, 451
- ARDITTI, J. (see YAM, T. W.), 317
- ARIYO, O. J. & ODULAJA, A., Numerical analysis of variation among accessions of okra [*Abelmoschus esculentus* L. Moench], Malvaceae, 527
- ARUMUGANATHAN, K., DALE, P. J. & COOPER, J. P., Vernalization in *Lolium temulentum* L.: responses of *in vitro* cultures of mature and immature embryos, shoot apices and callus, 173
- ASCASO, C. (see MARTÍNEZ, F.), 239
- AUFHAMMER, W. (see STÜTZEL, H.), 187
- BABBAR, S. (see SHEORAN, I. S.), 425
- BAL, A. K. & SIDDIQUE, A. B. M., Fine structure of peanut root nodules induced by nod⁺fix⁻ strains of *Bradyrhizobium* with special reference to lipid bodies, 309
- BAUM, S. F. (see ALONI, R.), 379
- , ALONI, R., PETERSON, C. A., Role of cytokinin in vessel regeneration in wounded *Coleus* internodes, 543
- BELCHER, A. R. (see JACKSON, M. B.), 229
- BERNARDELLO, L. M., GALETTO, L. & JULIANI, H. R., Floral nectar, nectary structure and pollinators in some Argentinean *Bromeliaceae*, 401
- BILL, O. (see NAGL, W.), 347
- BORRELL, A. K., INCOLL, L. D. & DALLING, M. J., The influence of the *Rht*₁ and *Rht*₂ alleles on the growth of wheat stems and ears, 103
- BROWN, S. A. (see ZOBEL, A. M.), 213
- BUNCE, J. A. & CAULFIELD, F., Reduced respiratory carbon dioxide efflux during growth at elevated carbon dioxide in three herbaceous perennial species, 325
- BUTLER, R. (see JACKSON, M. B.), 229
- CALVIN, C. L., WILSON, C. A. & VARUGHESE, G., Growth of longitudinal strands of *Phoradendron juniperinum* (Viscaceae) in shoots of *Juniperus occidentalis*, 153
- CAMERON, J. (see JACKSON, M. B.), 229
- CANNY, M. J. (see VARNEY, G. T.), 357
- CARRON, M. P. (see EL HADRAMI, I.), 511
- CAULFIELD, F. (see BUNCE, J. A.), 325
- CAUSTON, D. R., Plant growth analysis: the variability of relative growth rate within a sample, 137
- CHANDRA SEKHAR, K. N. & SAWHNEY, V. K., Regulation of leaf shape in the solanifolia mutant of tomato (*Lycopersicon esculentum*) by plant growth substances, 3
- CHAPMAN, D. F., ROBSON, M. J. & SNAYDON, R. W., The influence of leaf position and defoliation on the assimilation and translocation of carbon in white clover (*Trifolium repens* L.). 1. Carbon distribution patterns, 295
- , ROBSON, M. J., SNAYDON, R. W., The influence of leaf position and defoliation on the assimilation and translocation of carbon in white clover (*Trifolium repens* L.). 2. Quantitative carbon movement, 303
- CHIDA, Y. & UEDA, K., Division of chloroplasts in a green alga, *Trebouxia potterii*, 435
- CHOWDHURY, J. B. (see JAIN, R. K.), 517
- COLEMAN, M., DAVIE, P., VESSEY, J. & POWELL, W., Intracloonal genetic variation for protoplast regenerative ability within *Solanum tuberosum* cv. Record, 459
- COOPER, J. P. (see ARUMUGANATHAN, K.), 173
- CORNARA, L. (see SERRATO-VALENTI, G.), 475
- COSTA TURA, J. (see MCKENZIE, K. A. D.), 383
- DALE, P. J. (see ARUMUGANATHAN, K.), 173
- DALLING, M. J. (see BORRELL, A. K.), 103
- D'AUZAC, J. (see EL HADRAMI, I.), 511
- DAVIE, P. (see COLEMAN, M.), 459
- DAY, J. P. (see AHMAD, I.), 521
- DILLENBURG, L. R. (see ROSA, L. M.), 51
- DRAYCOTT, A. (see GREENWOOD, D. J.), 181
- DUTE, R. R. (see KUANG, A.), 23
- EAGLES, C. F. (see GAY, A. P.), 339

- EL HADRAMI, I., CARRON, M. P. & D'AUZAC, J., Influence of exogenous hormones on somatic embryogenesis in *Hevea brasiliensis*, 511
- ELLIS, B. A. (see LARIGAUDERIE, A.), 97
- EWING, E. E. (see VAN DEN BERG, J. H.), 191
- , (see LORENZEN, J. H.), 191
- FERRER, M. A., MUÑOZ, R. & ROS BARCELÓ, A., A biochemical and cytochemical study of the cuticle-associated peroxidases in *Lupinus*, 561
- FORDHAM, R. (see RAHIM, M. A.), 167
- FORD-LLOYD, B. V. (see JUNED, S. A.), 199
- FORSETH, I. N. (see ROSA, L. M.), 51
- GALETTI, L. (see BERNARDELLO, L. M.), 401
- GAMBARDELLA, R. & ALFANO, F., Plastid tubules in the sporogenous lineage of the moss *Timmiella barbuloidea* (Bryophyta): an ultrastructural study, 555
- GASTAL, F. (see GREENWOOD, D. J.), 181
- GAY, A. P. & EAGLES, C. F., Quantitative analysis of cold hardening and dehardening in *Lolium*, 339
- GOSSE, G. (see SHEEHY, J. E.), 131
- GREENWOOD, D. J., GASTAL, F., LEMAIRE, G., DRAYCOTT, A., MILLARD, P. & NEETESON, J. J., Growth rate and % N of field grown crops: theory and experiments, 181
- HALL, K. C. (see JACKSON, M. B.), 229
- HANSEN, A., PATE, J. S. & HANSEN, A. P., Growth and reproductive performance of a seeder and a resprouter species of *Bossiaea* as a function of plant age after fire, 497
- HANSEN, A. P. (see HANSEN, A.), 497
- HARMER, R., The effect of bud position on branch growth and bud abscission in *Quercus petraea* (Matt.) Liebl., 463
- HATCH, D. J. & MACDUFF, J. H., Concurrent rates of N₂ fixation, nitrate and ammonium uptake by white clover in response to growth at different root temperatures, 265
- HUANG, B. R., TAYLOR, H. M. & MCMICHAEL, B. L., Effects of temperature on the development of metaxylem in primary wheat roots and its hydraulic consequence, 163
- HUME, D. E., Leaf and tiller production of prairie grass (*Bromus willdenowii* Kunth) and two ryegrass (*Lolium*) species, 111
- , Effect of cutting on production and tillering in prairie grass (*Bromus willdenowii* Kunth) compared with two ryegrass (*Lolium*) species. 1. Vegetative plants, 533
- HUNT, R., 1
- HUTCHINSON, J. F. (see MILLER, R. M.), 35
- HUYGHE, C., Winter growth of autumn-sown white lupin (*Lupinus albus* L.): main apex growth model, 429
- ICHIHASHI, S. (see YAM, T. W.), 317
- INCOLL, L. D. (see BORRELL, A. K.), 103
- INGRAM, D. S. (see AHMAD, I.), 521
- JACKSON, M. B., ABBOTT, A. J., BELCHER, A. R., HALL, K. C., BUTLER, R. & CAMERON, J., Ventilation in plant tissue cultures and effects of poor aeration on ethylene and carbon dioxide accumulation, oxygen depletion and explant development, 229
- JACKSON, M. T. (see JUNED, S. A.), 199
- JAIN, R. K., JAIN, S. & CHOWDHURY, J. B., *In vitro* selection for salt tolerance in *Brassica juncea* L. using cotyledon explants, callus and cell suspension cultures, 517
- JAIN, S. (see JAIN, R. K.), 517
- JONES, A. V. (see ANDREWS, M.), 451
- JULIANI, H. R. (see BERNARDELLO, L. M.), 401
- JUNED, S. A., JACKSON, M. T. & FORD-LLOYD, B. V., Genetic variation in potato cv. Record: evidence from *in vitro* 'regeneration ability', 199
- KARNI, L. (see ALONI, B.), 371
- KAUL, V. (see MILLER, R. M.), 35
- KAUSHIK, A. (see KHATRI, R.), 413
- KEYES, G. J. (see PAOLILLO, Jr D. J.), 479
- KHATRI, R., SETHI, V. & KAUSHIK, A., Inter-population variations of *Kochia indica* during germination under different stresses, 413
- KIGEL, J. (see KONSENS, I.), 391
- KNAPP, B. (see NAGL, W.), 347
- KONSENS, I., OFIR, M. & KIGEL, J., The effect of temperature on the production and abscission of flowers and pods in snap bean (*Phaseolus vulgaris* L.), 391
- KRIKORIAN, A. D. (see SMITH, D. L.), 443
- KUANG, A., PETERSON, C. M. & DUTE, R. R., Changes in soybean raceme and petiole anatomy induced by 6-benzylaminopurine, 23
- KUMMEROW, J. (see LARIGAUDERIE, A.), 97
- LANGENKAMP, M. (see MOORE, R.), 279
- LARIGAUDERIE, A., ELLIS, B. A., MILLS, J. N. & KUMMEROW, J., The effect of root and shoot temperatures on growth of *Ceanothus greggii* seedlings, 97
- LAWLOR, D. W. (see MITCHELL, R. A. C.), 7
- LEE, C. H. (see NOBEL, P. S.), 549
- LEMAIRE, G. (see GREENWOOD, D. J.), 181
- LO GULLO, M. A. & SALLEO, S., Three different methods for measuring xylem cavitation and embolism: a comparison, 417
- LORENZEN, J. H. & EWING, E. E., Changes in tuberization and assimilate partitioning in potato (*Solanum tuberosum*) during the first 18 days of photoperiod treatment, 191
- MACDONALD, M. V. (see AHMAD, I.), 521
- MACDUFF, J. H. (see HATCH, D. J.), 265
- MACKENZIE, K. A. D. & COSTA TURA, J., Xylem development in the gynoeceum of the apple (*Malus pumila* L.) cv. Cox's Orange Pippin, 383
- MAIMON, E. & MOORE, R., Graviresponsiveness of surgically altered primary roots of *Zea mays*, 145
- MANTELL, S. H. (see ALIZADEH, S.), 257
- MARTÍNEZ, F., ASCASO, C. & ORÚS, M. I., Morphometric and stereologic analysis of *Chlorella vulgaris* under heterotrophic growth conditions, 239
- MCCULLY, M. E. (see VARNEY, G. T.), 357
- MCKENZIE, B. A. (see ANDREWS, M.), 451

- McKINLESS, J. & ALDERSON, P. G., An anatomical study of rhizome bud formation induced by paclobutrazol and adventitious root formation in *in vitro* cultures of *Lapageria rosea* (Ruiz et Pav.), 331
- McMICHAEL, B. L. (see HUANG, B. R.), 163
- MEAKIN, P. J. & ROBERTS, J. A., Anatomical and biochemical changes associated with the induction of oilseed rape (*Brassica napus*) pod dehiscence by *Dasineura brassicae* (Winn.), 193
- MILLARD, P. (see GREENWOOD, D. J.), 181
- MILLER, R. M., KAUL, V., HUTCHINSON, J. F. & RICHARDS, D., Adventitious shoot regeneration in carnation (*Dianthus caryophyllus*) from axillary bud explants, 35
- MILLS, J. N. (see LARGAUDERIE, A.), 97
- MITCHELL, R. A. C., LAWLOR, D. W. & YOUNG, A. T., Dark respiration of winter wheat crops in relation to temperature and simulated photosynthesis, 7
- MODENESI, P. (see SERRATO-VALENTI, G.), 475
- MOORE, R. (see MAIMON, E.), 145
- , LANGENKAMP, M., Tissue partitioning during leaf development in ornamentally-grown *Frithia pulchra* (Mesembryanthemaceae), a 'window plant', 279
- MULLINS, M. G. (see PLUMMER, J. A.), 17
- MUÑOZ, R. (see FERRER, M. A.), 561
- NAGL, W., KNAPP, B. & BILL, O., The complex satellite DNA of *Tropaeolum majus* L.: partial characterization of isolated and of cloned restriction fragments, 347
- NEETESON, J. J. (see GREENWOOD, D. J.), 181
- NIGHSWANDER, J. E. (see ZOBEL, A. M.), 213
- NIKLAS, K. J., Biomechanical responses of *Chamaedorea* and *Spathiphyllum* petioles to tissue dehydration, 67
- NOBEL, P. S. (see ALM, D. M.), 59
- , LEE, C. H., Variations in root water potentials: influence of environmental factors for two succulent species, 549
- ODULAJA, A. (see ARIYO, O. J.), 527
- OFIR, M. (see KONSENS, I.), 391
- ORÚS, M. I. (see MARTÍNEZ, F.), 239
- PAOLILLO, Jr D. J., SORRELLS, M. E. & KEYES, G. J., Gibberellic acid sensitivity determines the length of the extension zone in wheat leaves, 479
- PASHKAR, K. (see ALONI, B.), 371
- PATE, J. S. (see HANSEN, A.), 497
- PENNAZIO, S. & ROGGERO, P., Rapid ethylene production in soybean in response to the cupric ion, 247
- PERIASAMY, K. & AMALATHAS, J., Absence of callose and tetrad in the microsporogenesis of *Pandanus odoratissimus* with well-formed pollen exine, 29
- PETERSON, C. A. (see BAUM, S. F.), 543
- PETERSON, C. M. (see KUANG, A.), 23
- PLUMMER, J. A., VINE, J. H. & MULLINS, M. G., Regulation of stem abscission and callus growth in shoot explants of sweet orange [*Citrus sinensis* L. Osbeck], 17
- POWELL, W. (see COLEMAN, M.), 459
- PRITCHARD, H. W., Water potential and embryonic axis viability in recalcitrant seeds of *Quercus rubra*, 43
- PROFUMO, P. (see SERRATO-VALENTI, G.), 475
- RAHIM, M. A. & FORDHAM, R., Effect of shade on leaf and cell size and number of epidermal cells in garlic (*Allium sativum*), 167
- RICHARDS, D. (see MILLER, R. M.), 35
- ROBERTS, J. A. (see MEAKIN, P. J.), 193
- ROBSON, A. D. (see SCOTT, B. J.), 251
- ROBSON, M. J. (see CHAPMAN, D. F.), 295, 303
- ROGGERO, P. (see PENNAZIO, S.), 247
- ROS BARCELÓ, A. (see FERRER, M. A.), 561
- ROSA, L. M., DILLENBURG, L. R. & FORSETH, I. N., Responses of soybean leaf angle, photosynthesis and stomatal conductance to leaf and soil water potential, 51
- SALLEO, S. (see LO GULLO, M. A.), 417
- SAWHNEY, V. (see SHEORAN, I. S.), 425
- SAWHNEY, V. K. (see CHANDRA SEKHAR, K. N.), 3
- SCOTT, B. J. & ROBSON, A. D., The distribution of Mg, P and K in the split roots of subterranean clover, 251
- SERRATO-VALENTI, G., CORNARA, L., MODENESI, P. & PROFUMO, P., The aril of the *Strelitzia reginae* Banks seed: structure and histochemistry, 475
- SETHI, V. (see KHATRI, R.), 413
- SHARMA, E. & AMBASHT, R. S., Biomass, productivity and energetics in Himalayan alder plantations, 285
- SHEEHY, J. E. (see WEBB, J.), 77
- , Theory of a crop enclosure system for measuring nitrogen fixation, photosynthesis, respiration and biological processes in the soil, 123
- , WEBB, J., Oxygen diffusion pathways and Nitrogen fixation in legume root nodules, 85
- , WOODWARD, F. I., GOSSE, G., Measurements of nitrogen fixation (C_2H_2), photosynthesis and respiration using an open system in the natural environment, 131
- SHEORAN, I. S., SAWHNEY, V., BABBAR, S. & SINGH, R., *In vivo* fixation of CO_2 by attached pods of *Brassica campestris* L., 425
- SIDDIQUE, A. B. M. (see BAL, A. K.), 309
- SINGH, R. (see SHEORAN, I. S.), 425
- SMITH, D. L. & KRİKORIAN, A. D., Growth and maintenance of an embryogenic cell culture of daylily (*Hemerocallis*) on hormone-free medium, 443
- SNAYDON, R. W. (see CHAPMAN, D. F.), 295, 303
- SORRELLS, M. E. (see PAOLILLO, Jr D. J.), 479
- STRUİK, P. C. (see VAN DEN BERG, J. H.), 191
- STÜTZEL, H. & AUFHAMMER, W., Dry matter partitioning in a determinate and an indeterminate cultivar of *Vicia faba* L. under contrasting plant distributions and densities, 487
- TAYLOR, H. M. (see HUANG, B. R.), 163

- THORNLEY, J. H. M., A model of leaf tissue growth, acclimation and senescence, 219
- UEDA, K. (see CHIDA, Y.), 435
- VAN DEN BERG, J. H., STRUIK, P. C. & EWING, E. E., One-leaf cuttings as a model to study second growth in the potato (*Solanum tuberosum*) plant, 191
- VARNEY, G. T., CANNY, M. J., WANG, X. L. & McCULLY, M. E., The branch roots of *Zea*. I. First order branches, their number, sizes and division into classes, 357
- VARUGHESE, G. (see CALVIN, C. L.), 153
- VESSEY, J. (see COLEMAN, M.), 459
- VINE, J. H. (see PLUMMER, J. A.), 17
- WANG, X. L. (see VARNEY, G. T.), 357
- WEBB, J. & SHEEHY, J. E., Legume nodule morphology with regard to oxygen diffusion and nitrogen fixation, 77
- , (see SHEEHY, J. E.), 85
- WILSON, C. A. (see CALVIN, C. L.), 153
- WOLFE, D. W., Low temperature effects on early vegetative growth, leaf gas exchange and water potential of chilling-sensitive and chilling-tolerant crop species, 205
- WOODWARD, F. I. (see SHEEHY, J. E.), 131
- YAM, T. W., ICHIHASHI, S. & ARDITTI, J., Callus growth and plantlet regeneration in taro, *Colocasia esculentia* var. *esculenta* L. Schott (Araceae), 317
- YOUNG, A. T. (see MITCHELL, R. A. C.), 7
- ZOBEL, A. M., BROWN, S. A. & NIGHSWANDER, J. E., Influence of acid and salt sprays on furanocoumarin concentrations on the *Ruta graveolens* leaf surface, 213

Subject Index

- Abelmoschus esculentus*, 527
Abromeitiella, 401
 Abscission, 371, 391
 Absence of callose, 29
 Acclimation, 219
 Acetylene reduction, 131
 Acid invertase, 371
 Acoustic method, 417
 Adventitious root formation, 379
Aechmea, 401
Agave deserti, 549
Agave deserti Engelm., 59
 Alkalinity, 413
Allium sativum L. cv. Bangladesh Local, 167
Allium sativum L. cv. Fructidor, 167
 Allocation ratio, 103
Alnus nepalensis D. Don, 285
Alternaria brassicicola, 521
 Ammonium, 265
 Analysis, 239
 Anatomical method, 417
 Anatomy, 23, 383
 Apex, 429
 Apical meristem culture, 173
 Apple, 383
 Argentinean *Bromeliaceae*, 401
 Aril structure, 475
 Assimilate translocation, 295
 Atmospheric carbon dioxide, 325
 Auxin, 543
Avena sativa L., 451

 BAP, 23
 Barley, 451
 Beans, 205
 Bell pepper (*Capsicum annuum* L. cv. Maor), 371
 Biomass, 285
 Biomass allocation, 97
 Biomechanics, 67
Bossiaea aquifolium, 497
Bossiaea ornata, 497
 Branch roots, 357
 Branches, 463
Brassica campestris L., 425
Brassica juncea, 517
Brassica napus, 521
Brassica napus L. cv. Bienvenu, 193
Brassica oleracea var. *gemmifera* L., 137
Bromelia, 401
Bromus willdenowii Kunth, 111, 451, 533
 Brussel sprouts, 137
 Bryophytes, 555
 Buds, 463

 Callus culture, 173
 Carbohydrate reserves, 303
 Carbon budget, 59
 Carbon dioxide, 131
 Carbon economy, 303
 Carnation, 35
 Carob tree, 417
 Carpel, 383
Ceanothus greggii (Trel.) Jeps., 97
 Cellular changes, 257
 Cellulase, 193
 Centrifugal cleavage, 29
Ceratonia siliqua L., 417
 Chilean Bellflower, 331
Chlorella vulgaris, 239
 Chloroplast division, 435
Citrus sinensis L. Osbeck cv. St Ives Valencia, 17
 Cloning, 347
 Clover, 77
 Cluster analysis, 527
 CO₂ fixation, 425
 Cocksfoot, 451
 Coconut water, 317
 Cold dehardening, 339
 Cold hardening, 205, 339
 Cold tolerance, 205
Coleus blumei, 543
Colocasia esculenta var. *esculenta* L. Schott (Araceae), 317
 Conductance, 205
 Corn, 145
 Cortex, 145
 Cotyledon explants, 257
 Cox's Orange Pippin, 383
 Critical concentration, 181
 Crown, 463
 Cryo-SEM, 77
 Cupric ion, 247
 Cut flowers, 35
 Cuticle, 561
 Cutting frequency, 533
 Cutting height, 533
 Cytokinin, 543
 Cytokinins, 35

Dactylis glomerata L., 451
Dactylis glomerata L. cv. Potomac, 325
 Dark respiration, 7
 Darnel, 173
Dasineura brassicae (Winn.), 193
 Daylily, 443
 Defoliation, 295, 303
 Desert, 59
Deuterocohnia, 401
 Development, 383
Dianthus caryophyllus L., 35
 Diffusion resistance, 85, 131
 Disease resistance, 521
 Division apparatus, 435
 Division cycle, 435
 Dry matter partitioning, 103
Dyckia, 401

 Editorial, 1
 Efficiencies, 285
 Elongation, 479
 Embryo culture, 173
 Embryonic axis, 43
 Emergence, 205
 Endogenous ABA, 17
 Endogenous IAA, 17
 Endophytic system, 153
 Energy flow, 285
 Epidermal cells, 167, 561
 Epidermis, 145
 Errata, 191, 191
 Ethylene, 17, 229, 247

- Explant, 35
 Extension zone, 479
- Fagaceae, 43
Festuca arundinaceae Shreb., 451
Ficus lyrata Warb., 229
 Floral nectar, 401
 Flower, 383
 Flower production, 391
Frithia pulchra, 279
 Furanocoumarins, 213
- Garlic, 167
 Genistein oxidation, 561
Gerbera jamesonii Bolus, 229
 Germination, 413
 Gibberellic acid, 479
 Gibberellin biosynthesis inhibitor, 331
Glycine max L., 247
Glycine max L. Merr., 23
Glycine max L. Merr. cv. Essex, 51
Glycine max L. Merr. cv. Fiskeby V, 77, 85
 Gravitropism (root), 145
 Growth, 219, 325, 429
 Growth analysis, 137, 205
 Growth coefficient, 7
 Growth rate, 153
 Gynoecium, 383
- Heat stress, 371
Helianthus annuus L., 137
 Heliotropism, 51
Hemerocallis cv. 'Autumn Blaze', 443
 Herbicide, 521
Hevea brasiliensis, 511
 High temperature, 391
 Himalayan alder, 285
 Histochemistry, 475
Hordeum vulgare L., 451
 Hormone-free medium, 443
 Hormones, 511
 Hydraulic conductivity, 163, 549
 Hydraulic method, 417
 Hydrogen, 123
 Hydrophobicity, 77
- Image, 239
In vitro, 17
In vitro selection, 517
 Intercellular pathways, 77
 Intracolonial variation, 459
 Irrigation, 7
 Italian ryegrass, 451
- Kochia indica* Wight (bui), 413
- Lapageria rosea* cv. Nashcourt, 331
 Leaf, 219, 487
 Leaf anatomy, 67
 Leaf appearance, 111, 533
 Leaf area, 111
 Leaf development, 279
 Leaf disc culture, 199
 Leaf expansion, 229, 451
 Leaf extension, 451
 Leaf shape, 3
 Light intensity, 167
 Lipid bodies, 309
Lolium multiflorum, 339
Lolium multiflorum Lam., 111, 533
Lolium multiflorum Lam., 451
Lolium perenne, 339
Lolium perenne L., 111, 451, 533
- Lolium perenne* L. cv. Linn, 325
Lolium temulentum L., 173
 Lucerne, 77, 85
Luffa cylindrica Roem., 379
Lupinus albus, 561
Lupinus albus L., 429
Lycopersicon esculentum, 3
Lycopersicon esculentum Mill., 137
- Magnesium, 251
 Maintenance respiration, 59
 Maize, 205, 357
Malus pumila L., 383
Medicago sativa L. cv. Arc, 325
Medicago sativa L. cv. Europe, 77, 85
 Mesembryanthemaceae, 279
 Micropropagation, 317, 331
 Microspore culture, 521
 Microsporogenesis, 29
 Mistletoe, 153
 Mixotrophic, 239
 Model, 219, 339, 429
 Monad formation, 29
 Monocotyledons, 67
 Mosses, 555
 Mucilage, 145
 Mutagenesis, 521
- Nasturtium, 347
 N-deficiency, 181
 Nectary structure, 401
 Net primary production, 285
 Nitrate, 265, 451
 Nitrogen, 533
 Nitrogen fixation, 77, 85, 123, 131, 265, 309
 Nitrogen nutrition, 7
 nod⁺fix⁻ *Bradyrhizobium*, 309
 Nodule, 85
 Nutrient distribution, 497
- Oak, 463
 Oat, 451
 Oilseed rape, 193
 Okra, 527
Opuntia ficus-indica, 549
 Osmotic adjustment, 205
 Osmotic stress, 413
 Oxygen, 85
 Oxygen diffusion, 77
- Paclobutrazol, 331
 Palindromic sequences, 347
Pandanus odoratissimus, 29
 Partitioning, 487
 Peanut, 309
 Peas, 205
 Pedicel, 383
 Perennial ryegrass, 111, 451, 533
 Peroxidase cytochemistry, 561
 Petioles, 67
Phalaris aquatica L., 451
Phaseolus vulgaris L., 205
Phaseolus vulgaris L. cv. Tenderette, 391
Phoradendron juniperinum Engelm. ex A. Gray subsp. *juniperinum*, 153
 Phosphorus, 251
 Photoautotrophic, 239
 Photoheterotrophic, 239
 Photoperiod, 111
 Photosynthesis, 51, 123, 205, 295
 Photosynthesis model, 7
 Physiological integration, 303
 Pistil, 383

- Pisum sativum* L., 205
 Plant % N, 181
 Plant growth, 97
 Plant growth substance, 3
 Plant mass, 181
 Plant regeneration, 517
 Plant surface, 213
 Plant tissue culture, 229
 Plantation age, 285
 Plantlet regeneration, 317
 Plastid tubules, 555
 Pod midge, 193
 Pod set, 391
 Pod shatter, 193
 Pods, 425
 Pollinators, 401
 Polygalacturonase, 193
 Poor aeration, 229
 Population, 413
 Potassium, 251
 Potato, 199
 Potato protoplasts, 459
 Prairie grass, 111, 451, 533
 Priming, 43
 Primordia, 429
 Principal component analysis, 527
 Processes, 339
Puya, 401

Quercus petraea, 463
Quercus rubra, 43

 Rachis, 23
 Recalcitrant seed, 43
 Red oak, 43
 Regenerated tracheary elements, 379
 Regeneration ability, 199
 Regenerative strategy, 497
 Regrowth, 533
 Relative growth rate, 181
 Reproductive effort, 497
 Reproductive organs, 371
 Respiration, 123, 325
 Restriction analysis, 347
 Rhizome bud, 331
 Rhizosphere, 59
Rht, 479
Rht genes, 103
 Root, 487
 Root diameter, 357
 Root formation, 317
 Root growth, 251
 Root length, 357
 Root number, 357
 Root system, 549
 Root temperature, 97, 265, 549
 Roots, 163
 Rubber-tree, 511
Ruta graveolens, 213
 Rye \times *Triticosecale* Wittm., 451

 Salinity, 413
 Salt sprays, 213
 Salt-tolerance, 517
 Satellite DNA complexity, 347
Secale cereale L., 451
 Secondary abscission zones, 17
 Seed set, 391
 Selection, 521
 Senescence, 219
 Shade, 167
 Shoot, 487
 Shoot temperature, 97

 Shrub legumes, 497
 Simulated acid rain, 213
 Simulation, 59
 Sink leaves, 371
 Site filling, 111, 533
 Snap bean, 391
 Soil, 59, 123
 Soil water, 549
 Soil-plant-atmosphere continuum, 549
Solanum aviculare, 257
Solanum tuberosum cv. Record, 199, 459
Solanum tuberosum L. cv. Red Craig's Royal, 229
 Solar irradiation, 549
 Solar tracking, 51
 Somaclonal variation, 199
 Somatic embryogenesis, 257, 443, 511
 Soybean, 23, 51, 77, 85, 247
 Spinach, 205
Spinacia oleracea L., 205
 Split root systems, 251
 Sporogenous cell lineage, 555
 Stem, 487
 Stem and ear development, 103
 Stereology, 239, 279
 Stigma, 383
 Stomata, 425
 Stomatal conductance, 51
 Stomatal index, 167
Strelitzia reginae seed, 475
 Style, 383
 Suboptimal temperature, 205
 Subterranean clover, 251
 Succulent, 59
 Sunflower, 137
 Sweet orange, 17

 Tall fescue, 451
 Taro, 317
 Taro extract, 317
 Temperature, 111, 163
 Thermal time, 429
Tillandsia, 401
 Tillering, 111, 533
 Tillering sites, 111
Timmermannia barbuloidea, 555
 Tissue culture, 35, 317, 443, 517
 Tomato, 3, 137
 Tracheary elements, 357
 Transmission electron microscopy, 435
 Transpiration, 59
Trebouxia potteri, 435
Trifolium repens cv. Blanca, 85
Trifolium repens L., 295, 303
Trifolium repens L. cv. Blanca, 77
Trifolium repens L. cv. Huia, 265
Trifolium subterraneum L., 251
 Triticale, 451
Triticum aestivum L., 103, 137, 163, 451, 479
Triticum aestivum var. Avalon, 7
Tropaeolum majus L., 347

 Ultrastructure, 309, 555
 UV light, 521

 Variance of relative growth rate, 137
 Variation, 527
 Varieties, 339
 Vascular differentiation, 379, 543
 Vasculature, 383
 Vernalization, 173, 429
 Vessel regeneration, 543
Vicia faba L., 487

Vitrification, 35
Vriesea, 401

Water potential, 43, 51, 59, 549
Water relations, 59
Water stress, 417
Water uptake, 357
Water-soluble carbohydrates, 533
Westerwolds ryegrass, 111, 533
Wheat, 103, 137, 163, 451, 479
White clover, 85, 265, 295, 303
White lupin, 429
Window plant, 279

Winter wheat, 7
Wound xylem, 543

Xylem, 383
Xylem development, 163
Xylem embolism, 417
Xylem regeneration, 379

Yield, 111, 533

Zea mays cv. Seneca Chief, 357
Zea mays L., 205
Zea mays Yellow Dent, 145

Copyright © 1991 Annals of Botany Company
ALL RIGHTS RESERVED

No part of this volume may be reproduced in any
form, by photostat, microfilm or any other means,
without written permission from the publishers

ISSN 0305 - 7364